

Jeff Wuensch

From: Frank Kelly [frank@nexustax.com]
Sent: Friday, April 25, 2008 9:31 AM
To: 'Schwab, David'
Subject: RE: corrected Spearman Rank Tests, etc.
Attachments: spearman scores.xls; resume fk 11-07.doc

From: Frank Kelly [mailto:frank@nexustax.com]
Sent: Thursday, April 17, 2008 9:34 AM
To: Schwab, David
Cc: Rushenberg, Tim; 'Shaw Friedman'; 'Jeff Wuensch'; 'Marilyn Meighen'; TAtherton@boselaw.com
Subject: corrected Spearman Rank Tests, etc.

Hello David,

Thanks for correcting my erroneous formula yesterday. I've corrected the formula and test scores in the attached spreadsheet. The results still indicate:

- Galena TWP vacant RES
insignificant test score; no evidence of assessment regressivity / progressivity.
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I've emailed Everett Davis the corrected DLGF ratio study. Hopefully if the DLGF concurs with the changes, your office can forward the study to all parties. Based on those revisions, and if you're in agreement with the results of this application of the Spearman test, that leaves Hanna TWP vacant RES and Hudson TWP vacant RES as outside the guidelines.

Regards,
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From: Schwab, David [mailto:DSchwab@dlgf.IN.gov]
Sent: Tuesday, April 22, 2008 8:14 AM
To: Frank Kelly
Subject: RE: corrected Spearman Rank Tests, etc.

Frank,

Thanks for sending this to me. I've been trying to replicate your results in my statistics program (R 2.5.1) and have been running into some trouble. I'm not sure where the problem lies, and because I don't know the specific algorithm R is using I don't want to rule out the possibility that my program is in error. In any event, I have a few questions which I hope you can clear up:

- 1) When calculating Spearman's Rank correlation coefficient, I believe the correct approach to tied ranks is to take the arithmetic mean of the tied ranks. This is what you do for Galena Twp, and in fact I can replicate this result with my program. However, for Hanna you only average the ranks for SP, even though AV has tied values. Also, for Springfield you repeat ranks for tied values. I'm unable to replicate these results in R, although to be fair R gives me slightly different results than when I average the ranks by hand for Hanna Twp. I haven't discovered the source of this discrepancy yet.
- 2) The help file for Spearman's Rank correlation coefficient for R (not the most authoritative source, I know) indicates that it can be used for paired data, meaning sample independence is not required. I haven't been able to verify this from other sources. I feel it is important for us to nail this down because if you are right it invalidates a widely used test for vertical inequity.
- 3) At the conceptual level, I don't think that showing a correlation exists (or does not exist) between assessed value and sale price is a reliable test of vertical inequity. You seem to suggest that when a correlation (not necc. linear) does not exist there is evidence of vertical inequity. I don't see how this follows: whether assessment and sales are correlated (and I would expect they would be if the ratio study is at all valid) or not tells me nothing about the distribution of the assessment data, which is what we need to measure to test for vertical inequity. Can you provide a justification for testing for vertical inequity in this way?

Thanks for your time; I look forward to hearing from you.

Sincerely,

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Thanks for the note David. I've been in Southern IN for most of the week, but wanted to answer your email.

On your points:

1. Hanna – I had overlooked averaging those ranks; now corrected in the attached file. No change in results. For Springfield, I double-checked all the ranks, using the mean rank for tied observations, but found no errors. All the ranks are off to the side for that analysis. So I'm not sure where the difference lies.
2. I've been thinking of this issue as well. I re-did all the Spearman tests using the difference in ranks between the (av/sp) and the rank of the AV only). In two of the 4 instances, this revision changed the results. Obviously, that's of concern in that if there was no difference in the formulation of the test or the underlying meaning, then our results should not change. However, I do believe that paired data for this test would have the meaning of independent data pertaining to the same observation (assessment vs. sale price). One just can't take any two paired observations and conduct a Spearman test. If we take square footage of each house and pair that with the assessment, we'd surely find the obvious linkage.

Unlike the Wilcoxon-Mann-Whitney test, I can't think of an easy example to prove the point. Perhaps we could work together to figure one out and write an article jointly for the *IAAO Property Tax and Administration Journal*? Jeff Wuensch and I are definitely going to send in the homogeneity example on the WMW test, coupled with the Michigan TWP res data as case in point. Hopefully, someone's interested in this circumstance outside of Indiana. I've written a few articles over the years – see attached.

3. I think the use of the Spearman test in this fashion relies to some extent on homogeneous data; in this case, observations that are fairly closely grouped. If the sales price observations are:

10000
 50000
 100000
 1000000

Then virtually any AV's would show no vertical inequity problem when using only the ranks of the AV's in comparison with the ranks of the sales prices. So let's then consider a more tightly grouped set of observations (such as what exists to some extent with the Hanna TWP vacant RES).

AV	SP
10000	5000
10000	8000
10000	10000
10000	12000
10000	15000

In this case there is significant regressivity as the assessments of the higher sales priced parcels do not receive a correspondingly higher assessment. Looking at only the differences in ranks (AV only vs. SP only) of each observation does indeed yield significant differences in the ranks. So this interpretation of the test does have power to discern regressivity / progressivity. The use of av/sp as the second source of ranks in other examples definitely produces findings more frequently, perhaps unjustifiably so.

My opinion is that using the Spearman as the vertical inequity test depends on the potential for independence

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between the two ranked criteria. I don't think we are necessarily concerned with the distribution of the assessment data (assuming a relatively small spread in the data) as much as we are concerned with how individual observations of the AV compare with individual observations of sales prices. Since we are only concerned with small samples, the overall distribution seems less relevant than the degree to which the two data fields of each observation compare with all the other observations. If in a narrowly varying group, the parcels with slightly higher sales prices are receiving slightly higher assessments (ie. the ranks match), then vertical inequity doesn't exist. The AV/Sp measure would have a more random distribution in that case, causing noise in the statistic (a background level of false positives). Perhaps that's the basis for a good example? Noise and a couple of problem parcels create a finding of vertical inequity when in fact, we have only a few problematic parcels.

Regardless, thanks for your thoughts and input. Up until the current fiasco, no one has bothered to ponder such questions in Indiana, including me unfortunately.
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